

PATENT SPECIFICATION

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NO DRAWINGS.

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COMPLETE SPECIFICATION.

Floor Coverings.

We, IMPERIAL CHEMICAL INDUSTRIES LIMITED, of Imperial Chemical House, Millbank, London, S.W.1, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to floor-coverings and more particularly to floor-coverings of a flexible nature which contain as an integral part of their structure a layer of flexible polyurethane foam.

It has already been proposed to apply to carpets an adherent backing of flexible polyurethane foam. By this means, the resilience and wearing properties of carpets of either a woven or tufted structure may be significantly improved. Carpets, however, are expensive articles and this additional operation of applying a layer of foam adds still further to their expense.

It has also been proposed to apply polyurethane foam backings to textile fabrics of the type used as clothing materials. The particularly foam-fabric combinations disclosed, however, although excellent for clothing purposes, have not been of a type suitable for use as floor-coverings. This is because the requirements are entirely different in the two cases. For clothing purposes the foam layer is only $\frac{1}{32}$ inch to $\frac{1}{16}$ inch thick and of very low density, because its function is to provide thermal insulation and crease resistance without making the garment too bulky.

For floor-coverings, on the other hand, the foam backing should be thick enough to provide the foam-fabric combination

with the luxurious feel underfoot of a carpet. Foam properties of importance in floor-coverings are resistance to compression and the ability to recover from compression rapidly and substantially completely.

It has now surprisingly been found that certain foam-fabric combinations are extremely useful as flexible floor-coverings surpassing the highest quality conventional carpets in wear resistance. The combinations in question comprise a surface layer of a textile fabric weighing from 4 to 12oz./sq.yd. and an adherent backing of flexible polyurethane foam having a thickness of at least $\frac{1}{4}$ inch and a density of between 2 and 5 lb./cu.ft., said combination having a compression per unit thickness, as hereinafter defined, of at least 70%.

Textile fabrics suitable for use in the flexible floor-coverings of the present invention include woven fabrics, knitted fabrics and felts. The said fabrics may be composed of natural or man-made fibres or blends thereof. Thus the fibres of which the fabrics are composed include wool, cotton, linen, viscose rayon, polyamide, polyester (for example polyethylene terephthalate), cellulose triacetate, polyacrylonitrile and any blend thereof.

The flexible polyurethane foam used as a backing in the floor-coverings of the present invention preferably has a thickness of between $\frac{1}{4}$ inch and $\frac{5}{16}$ inch. A foam density of between 2 $\frac{1}{2}$ and 3 lb./cu.ft. has been found to be particularly suitable.

The polyurethane foam may be prepared by the conventional procedure of reacting an organic polyisocyanate in one or more stages with a polyhydroxy compound such

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as a hydroxyl group-containing polyester, polyesteramide or polyether in the presence of a gas-generating agent, examples of the latter being water and inert liquids of low boiling point. The usual surface-active agents, for example oxyethylated phenols and organosiloxane polymers, and catalysts, for example tertiary amines and organic compounds of metals, may be employed. There may also be used reconstituted scrap foam prepared, for example, by bonding fragments of scrap foam with a suitable adhesive.

The backing of flexible polyurethane foam may be applied to the textile fabric either by allowing foam formation to take place in contact with the textile material or by bonding a layer of previously prepared foam to the fabric. Where the foam is prepared *in situ* the foam-forming reaction mixture may be applied to the fabric by spraying, spreading or any other conventional method. Where a previously prepared layer of foam is bonded to the fabric, any elastomer based or thermoplastic adhesive may be used. Suitable elastomers include polyurethanes, natural rubber, polychloroprene and butadiene/acrylonitrile or butadiene/methacrylate copolymers. The elastomers may be mixed with curing agents before application and the adhesive in the laminates may be cured by heat or other methods. The polyurethane elastomers are particularly suitable because by reaction with polyisocyanates the adhesives may be fully cured at room or elevated temperatures to give a bond resistant to washing and dry cleaning. Suitable thermoplastic adhesives include polyethylene, polyvinyl chloride and certain polyamides.

The invention is illustrated but not

limited by the following Examples 5-12. Examples 1-4 are included for the sake of comparing conventional carpets with the flexible floor coverings of the present invention.

Example 1

A good quality all-wool Wilton carpet having 72 tufts per sq.in. and a total weight of 59 oz./sq.yd. was laid on a stone stairs without an underlay. After 5000 treads it had retained 90.2% of its original thickness and 73.8% of its original compression. Its original compression per unit thickness of 39.3% dropped to 32.1% after 5000 treads.

After 1000 cycles of the Wool Industries Research Association Dynamic Loading Test the sample had retained 78% of its original thickness ($\frac{3}{4}$ p.s.i.) and 68% of its original compression ($\frac{3}{4}$ and 12 p.s.i.). In the Wool Industries Research Association abrasion test the sample required 3,500 revs.

The efficacy of cleaning by vacuum and shampoo was very good. After 5000 treads there was some pile damage at the nose of the stair. After 1000 cycles of the Dynamic Loading Test, the pile had been flattened considerably.

The measurements and tests applicable to this and the following examples are as follows:

Let h be the sample thickness under a small load ($\frac{3}{4}$ p.s.i.)
Let h^1 be the sample thickness under a load of 12 p.s.i. (which is about equal to that of a man's foot)
then $h - h^1$ is the compression.
The following properties are defined:—

After n treads
 $h_n \cdot 100$

$= \frac{h_n}{h_0}$

$= \frac{(h - h^1)_n \cdot 100}{(h - h^1)_0}$

$= \frac{(h - h^1)_n \cdot 100}{(h - h^1)_0}$

$= \frac{(h - h^1) \cdot 100}{h}$

% of original thickness retained

% of original compression retained

Compression per unit thickness (%)

The Dynamic Loading Test of the Wool Industries Research Association (W.I.R.A.) is described in J.Text.Inst. 53, 1962, T 347 and is as follows:—

A weight having two steel feet of rectangular cross-section (2" wide, $\frac{1}{4}$ " long and $\frac{1}{8}$ " deep) is raised by a motor-driven cam and falls freely from a height of 2". The sample is clamped underneath and is moved slowly and continuously in a horizontal plane in such a way that there is $\frac{1}{8}$ " move-

ment between each drop of the weight. The maximum movement of the sample while the feet are in contact is 0.02". The abrasive component is therefore negligible.

The following measurements are made:

Let t be the sample thickness under a small load of $\frac{3}{4}$ p.s.i.

Let t^1 be the sample thickness under a load of 12 p.s.i.

Compression = $t - t^1$

After n cycles:

$$\% \text{ of original thickness retained} = \frac{t_n}{t_0} \cdot 100$$

$$\% \text{ of original compression retained} = \frac{(t - t'_n) \cdot 100}{(t - t'_0)}$$

The Abrasion Test of the Wool Industries Research Association is described in W.I.R.A. Bull. 18, 2, p. 55, and is as follows:

Two vertical shafts are driven in the same direction at the same speed but with the centres of the two shafts out of line. The sample of $1\frac{1}{2}$ " diameter is clamped to the top of the lower shaft, face upwards. A standard crossbred woollen tie lining is fixed to the upper shaft. The diameter of this abrading surface is higher than the sample diameter. The pressure exerted between the two rotating shafts when in contact is 8 p.s.i.

The machine is operated until the backing of the sample is exposed. The number of revolutions necessary for this is recorded.

Unless otherwise stated, thickness and compression results in those examples refer to measurements made under $\frac{1}{4}$ p.s.i. and $\frac{1}{2}$ and 12 p.s.i. respectively.

Example 2

A good quality all-wool Wilton carpet having 95 tufts per sq.in. and a total weight of 78 oz./sq.yd. was laid on stone stairs without an underlay. After 5000 treads it has retained 91.3% of its original thickness and 67.7% of its original compression. Its original compression per unit thickness was 47.1% which dropped to 34.9% after 5000 treads.

The efficacy of cleaning by vacuum and shampoo was very good. After 5000 treads there was some pile damage at the nose of the stair.

Example 3

The same Wilton carpet as in Example 2 was laid over a conventional felt stair-pad. After 5000 treads it had retained 92.3% of its original thickness and 74.9% of its original compression. Its original compression per unit thickness was 45.7% which dropped to 37.1% after 5000 treads. The efficacy of cleaning by vacuum and shampoo was very good. After 5000 treads there was slight pile damage at the nose of the stair.

Example 4

A pile carpet of the type commonly used in motor cars was laid as described in Example 1. The pile adheres to but does not penetrate the hessian backing. After 5000

treads it had retained 71.5% of its original thickness and 50.1% of its original compression. Its original compression per unit thickness was 46% which dropped to 32.3% after 5000 treads. Its efficacy of cleaning by vacuum and shampoo was very good. After 5000 treads it was badly worn, especially at the nose.

Example 5

A flexible floor-covering comprising a surface layer of an 8.7 oz./sq.yd. woven wool tweek having a broken twill weave and a backing of $\frac{1}{4}$ " thick polyurethane foam having a density of 2.8 lb./cu.ft. bonded to the surface layer by means of a polyurethane-based adhesive of the type described in our Specification No. 945,261 was laid on stairs as described in Example 1. After 5000 treads it had retained 93.2% of its original thickness and 93.2% of its original compression. Its compression per unit thickness was 77.6% originally and after 5000 treads.

After 1000 cycles of the W.I.R.A. Dynamic Loading Test the sample had retained 83% of its original thickness ($\frac{1}{4}$ p.s.i.) and 78.5% of its original compression ($\frac{1}{4}$ and 12 p.s.i.). In the W.I.R.A. abrasion test, the sample required 3000

revs. The efficacy of cleaning by vacuum and shampoo was fair. After 5000 treads there was some evidence of fibre loss but otherwise it had worn well. After 1000 cycles of the W.I.R.A. Dynamic Loading Test the sample showed no signs of wear.

Example 6

A flexible floor-covering comprising a surface layer of a 5.3 oz./sq.yd. woven wool flannel, plain weave, bonded by means of a polyurethane-based adhesive to a backing of the polyurethane foam described in Example 5 was laid on stairs as described in Example 1. After 5000 treads it had retained 95% of its original thickness and 96.2% of its original compression. Its compression per unit thickness was 81% originally and 82% after 5000 treads.

After 1000 cycles of the W.I.R.A. Dynamic Loading Test the sample had retained 83.5% of its original thickness ($\frac{1}{4}$ p.s.i.) and 81% of its original compression ($\frac{1}{4}$ and 12 p.s.i.). In the W.I.R.A. abrasion test, the sample required 1800 revs.

The efficacy of cleaning by vacuum and shampoo was fair. Apart from some slight loss of fibre it had worn well after 5000 treads. After 1000 cycles of the W.I.R.A. Dynamic Loading Test, the sample showed no signs of wear. There were no signs of wear after 5000 treads or after 1000 cycles of the W.I.R.A. Dynamic Loading machine.

Example 7

A flexible floor-covering comprising a surface layer of an 8 oz./sq.yd. cotton fabric, twill weave, bonded by means of a polyurethane-based adhesive to a backing of $\frac{1}{16}$ " thick flexible polyurethane foam having a density of 2.2 lb./cu.ft. was laid on stairs as described in Example 1. After 5000 treads it had retained 95.5% of its original thickness and 98.5% of its original compression. Its compression per unit thickness was 81.9% originally and 84.4% after 5000 treads.

After 1000 cycles of the W.I.R.A. Dynamic Loading Test, the sample had retained 90% of its original thickness ($\frac{3}{4}$ p.s.i.) and 91.5% of its original compression ($\frac{3}{4}$ and 12 p.s.i.). In the W.I.R.A. abrasion test, the sample required 3000 revs.

The efficacy of cleaning by vacuum and shampoo was fair. There was no signs of wear after 5000 treads or after 1000 cycles of the W.I.R.A. Dynamic Loading machine.

Example 8

A flexible floor covering comprising a surface layer of a 5.4 oz./sq.yd. viscose rayon fabric, plain weave, bonded by means of a polyurethane-based adhesive to a backing of the polyurethane foam described in Example 8 was laid on stairs as described in Example 1. After 5000 treads it had retained 97.5% of its original thickness and 99.1% of its original compression. Its compression per unit thickness was 85.1% originally and 86.6% after 5000 treads.

After 1000 cycles of the W.I.R.A. Dynamic Loading Test, the sample had retained 89% of its original thickness ($\frac{3}{4}$ p.s.i.) and 89.5% of its original compression ($\frac{3}{4}$ and 12 p.s.i.). In the W.I.R.A. abrasion test the sample required 7000 revs.

The efficacy of cleaning by vacuum and

shampoo was good. There were no signs of wear after 5000 treads or after 1000 cycles of the W.I.R.A. Dynamic Loading Test.

Example 9

A flexible floor covering comprising a surface layer of a 5 oz./sq.yd. needled felt of polyethylene terephthalate and polypropylene fibres bonded by means of a polyurethane-based adhesive to a backing of $\frac{1}{2}$ " thick flexible polyurethane foam having a density of 2.4 lb./cu.ft. was laid on stone stairs as described in Example 1. After 5000 treads it had retained 89.7% of its original thickness and 89.5% of its original compression. Its compression per unit thickness was 73.5% originally and after 5000 treads. The efficacy of cleaning by vacuum and shampoo was poor. The sample had not worn after 5000 treads apart from slight damage on the nose of the stair.

WHAT WE CLAIM IS:—

1. Floor-coverings comprising a surface layer of a textile fabric weighing from 4 to 12 oz./sq.yd. and an adherent backing of flexible polyurethane foam having a thickness of at least $\frac{1}{4}$ inch and a density of between 2 and 5 lb./cu.ft., said floor-covering having a compression per unit thickness, as hereinbefore defined, of at least 70%.
2. Floor-coverings as claimed in claim 1 wherein the foam has a thickness of between $\frac{1}{4}$ and $\frac{7}{16}$ inch.
3. Floor-coverings as claimed in claim 1 or claim 2 wherein the foam has a density of between $2\frac{1}{2}$ and 3 lb./cu.ft.
4. Floor-coverings as claimed in any one of the preceding claims wherein the surface layer of textile fabric is bonded to the polyurethane foam backing by means of a polyurethane-based adhesive.
5. Floor-coverings substantially as hereinbefore described with reference to Examples 5—9.

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